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ABSTRACT

A model of attitudes change having the mathematical characteristics of a hyperbolic function, with major parameters determined by source credibility and discrepancy, is proposed and tested against leading established models of attitude change. The proposed hyperbolic model proved to be a more accurate predictive device than either of the two competing formulations. (Author)

A PRELIMINARY INVESTIGATION OF A HYPERBOLIC MODEL OF ATTITUDE CHANGE[1,2]

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Abstract

A model of attitude change having the mathematical characteristics of a hyperbolic function, with major parameters determined by source credibility and discrepancy, is proposed and tested against leading established models of attitude change. The proposed hyperbolic model proved to be a more accurate predictive device than either of the two competing formulations.

Common sense and social psychology both suggest that two of the most important factors influencing the effectiveness of a persuasive communication are the credibility of the source of the message and the discrepancy between the communication and the established beliefs of the receiver. The functional relationship between each of these two factors and attitude change has received

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much research attention, but consensus regarding the relationship between these two critical components has, as yet, failed to materialize (Sears & Abelas, 1969). Typically, studies involving the manipulation of discrepancy between the message and subjects' attitudes have obtained direct linear relationships between discrepancy and change; at extreme levels of discrepancy, however, the strength of this relationship usually decreases (Fisher & Lubin, 1958; Freedman, 1964; Hovland & Pritzker, 1957; Sherif & Hovland, 1961; Sherif, Sherif, & Nebergall, 1965; Zimbardo, 1960). Studies involving the manipulation of both source credibility and discrepancy have generally indicated a curvilinear relationship between discrepancy and change (Aronson, Turner, & Carlsmith, 1963; Bochner & Insko,1966; Choo, 1964). A review of the literature, however, indicates that in general, mathematical models of attitude change have not addressed themselves to the question of this curvilinearity; this paper is a preliminary report on the development of a model which directly predicts the relationships described in the literature cited above.

Perhaps the theoretical position most relevant for the model to be described derives from the theory of cognitive dissonance (Festinger, 1957). If some discrepancy exists between a subject's original position and a message, dissonance is thought to be created in direct proportion to the amount of discrepancy. This theoretical framework postulates two obvious mechanisms for coping with this dissonance: the derogation of the source of the message, or a change in attitude, such that the revised cognition becomes consonant with the message. If the credibility of the communicator is held constant, at some

moderate or intermediate level, then the greater the discrepancy, the more likely it is that communicator derogation will occur, producing less attitude change and resulting in a curvilinear relationship between discrepancy and change. Since a perfectly credible communicator could not be derogated, one would expect a linear relationship at maximum credibility. Finally, if the communicator were perfectly incredible, no change at any discrepancy would be expected, since such a communicator is already derogated and would produce no dissonance. Results consistent with these expectations have appeared in the social psychological literature (Aronson et al., 1963; Brewer & Crano, 1968).

The present paper summarizes an initial attempt to construct a mathematical model consistent with the considerations outlined above. Briefly, the properties of the sought-for model should result in the prediction of (a) a positive linear relationship between discrepancy and change with a source of perfect credibility, (b) no relationship between these factors with a perfectly incredible source, and (c) a curvilinear, inverted U-shaped function between discrepancy and change with sources between these extremes.

Mathematically, a hyperbolic function, given appropriate restrictions, best satisfies the criteria developed on the basis of the theoretical expectations and empirical results discussed above. In the derivation of this model, we define our attitude scale as having a range of -1 to +1 (other scales can be appropriately transformed to this scale), with -1 being the most negative attitude possible, and +1 the most positive. On this scale, the

maximum possible change and the maximum possible discrepancy are two units. Using this scale, we define discrepancy to be the absolute difference between the subject's initial position on the scale and the position advocated in the persuasive message.

We define credibility as having values ranging from 0 to +1, with 0 representing a perfectly incredible source, and +1 a perfectly credible one. Given these definitions (with D = discrepancy, and c = credibility), the initial hyperbolic model is given by formula 1, where a positive attitude change (AC) indicates a change in the direction of the message. Some members of the family of

$$(1) \qquad AC = 2c - \sqrt{(1-c) \cdot (2c)^2 + (c) \cdot (2c-D)^2}$$

curves produced by the manipulation of the parameter values of this formula are given in Figure 1 (the reader is directed to employ the left and bottom axes in reading this figure for formula 1).

Insert Figure 1 about here

Some of the interesting characteristics of this model can be noted in Figure 1. If credibility (c) is set equal to +1, that is, if the message emanates from a perfectly credible source, attitude change is predicted to be equal to the discrepancy (D), and the final attitude of the subject is <u>exactly</u> that advocated by the message. If c is replaced by zero, then for all discrepancy values, the formula predicts no change, a theoretical expectation developed above. The remaining values of c and D interact such that:

(a) with decreasing c values, the inflection point of the hyperbolic

function (i.e., the point at which attitude change declines) is reached at ever decreasing levels of discrepancy (D); thus, decreasing amounts of attitude change can be expected in response to a constant D value as c decreases;

(b) as c increases, the point of inflection of the function also increases, and thus greater D values are accomodated, resulting in increased attitude change (AC) with increases in D.

Although this model is of interest in and of itself, a more interesting formulation can be obtained by replacing the constant in the equation, which reflects the maximum discrepancy possible on the attitude scale. If this value is replaced with a variable representing the maximum possible discrepancy which can be experienced by the subject in the same direction as that advocated by the message (i.e, the distance between his initial attitude and the advocated endpoint of the attitude scale), then the model can be represented as in formula 2, where D_m represents this new variable.

$$(2) \qquad AC = (c \cdot D_m) - \sqrt{(1-c) \cdot (c \cdot D_m)^2 + (c) \cdot (c \cdot D_m - D)^2}$$

This new model is somewhat more complicated to depict graphically. However, it can be shown that by dividing both sides of the equation by D_m we obtain formula 3, and by expressing the discrepancy and

$$(3) \qquad AC/D_m = (c) - \sqrt{(1-c) \cdot (c)^2 + (c) \cdot (c-(D/D_m))^2}$$

attitude change in relative units as the percentage of D_m, we can obtain formula 4. This formula can be represented by the same graph as presented in Figure 1 if the top and right axes are employed.

$$(4) \qquad AC_r = (c) - \sqrt{(1-c) \cdot (c)^2 + (c) \cdot (c-D_r)^2}$$

It should be noted, however, that although these two models can be represented by the same graph, the relabeling of the axes is significant, in that the models make substantially different predictions, since in one case the discrepancy and change values are absolute, and in the other, they are relative to the maximum discrepancy that can be perceived by the individual subject. (For example, if we set c to 0.5, the initial attitude to 0, and the message to +1, the model of formula 1 predicts an attitude change of .29 units in the direction advocated, for a final attitude of +.29. With the model of formula 4, the discrepancy is interpreted in terms of D which is +1 in this case, and the relative discrepancy is +1/+1, or 100%; formula 4 thus predicts no attitude change, given 100% discrepancy and a c value of 0.5. The two predictions may be derived from Figure 1.) Of the three forms of the second model, formula 2 is probably the easiest to use and comprehend, and will thus be discussed below.

The model depicted in formula 2 uses three variables: the subject's initial attitude, the value of the persuasive communication, and the credibility of the source. It was hypothesized that such a model might represent a substantial improvement over previous models of attitude change. With this in mind, this model was tested in a preliminary fashion on data collected in other research (Cooper, 1971; Cooper & Crano, 1971) which investigated two of the more popular models of attitude change, Osgood's congruity model and Fishbein's theory of cognitive summation. The essentials of the data collection relevant to the present paper are as follows: One hundred-twenty undergraduates served in the experiment, which was described as an investigation of the effects of phrases in

letters of recommendation (cf. Brewer, 1968). The subjects were first given information concerning the object person and then rated this person on semantic differential evaluative scales (pretest). They were then presented with either one, two, or four units of additional information in the form of excerpts from letters of recommendation. This was followed by a second evaluation of the object person on semantic differential scales (posttest) and by ratings of the units of information presented. In addition, subjects rated the likelihood that the object person actually possessed the qualities attributed to him in the excerpts.

Predictions for the Osgood and Fishbein models were calculated according to the formulae presented in Cooper & Crano (1971). In order to calculate the predictions for the hyperbolic model, it was necessary to assume that the "likelihood" ratings constituted a measure of the credibility of the source of the message. Formula 2 was applied once, twice, or four times in an iterative manner, depending upon the number of phrases received by the subject. The predictions for each of the competing models were correlated with the obtained posttest values, and the correlations compared by t tests for nonindependent correlations (Edwards, 1960). The predictions of the hyperbolic model were found to correlate .73 with the observed values; this result significantly exceeded that obtained in testing the Osgood model ($r=.49$, $p<.01$), and marginally exceeded that of the Fishbein formulation ($r=.63$, $p<.10$).

These findings are indicative of the potential capabilities of the as-yet undeveloped hyperbolic model of attitude change. It

should be noted, in forming an initial evaluation of this device, that the value of the very important credibility (c) parameter was derived from measures not specifically tailored to the needs of the model. With a more precise estimate of this value, it seems certain that the predictive accuracy of the model would be enhanced appreciably.

One of the useful characteristics of this type of model is its openness to the inclusion of variables reflecting other aspects of the attitude change process, thereby allowing for continuing improvement of predictive capabilities. One such variable, the degree of certainty with which the subject makes his pretest rating, is currently being tested in a revised form of the hyperbolic model. This variable, which might be reflective of the amount of material known to the subject before the pretest, makes for a modification of the basic model such that with little certainty, change is more likely than with great certainty. If p represents a measure of this factor, with the restriction that p must be positive, then this new formulation takes the appearance of figure 5. Remembering that

$$(5) \qquad AC = (c \cdot D_m) - \sqrt{(1-c^p) \cdot (c \cdot D_m) + (c^p) \cdot (c \cdot D_m - D)^2}$$

p is restricted to a range of 0 to 1, the effect of p=0 is the same as having a source of perfect credibility; that is, if the subject is totally uncertain as to his attitude, the model predicts that he will accept any position advocated by the source. As the value of p increases, the model predicts that change will decrease for any value of D or c (except when c=1), due to a decrease in the weight afforded the discrepancy term. As p increases, this effect approaches

a limit, to the point that no change occurs for the maximally certain subject. Note that certainty might also be conceptualized as a chronic personality dimension, somewhat analogous to dogmatism, or open- and closemindedness. If this supposition proves reasonable, this approach allows for the potential integration of cognitive consistency and cognitive complexity components in the same model, a development seen by some (e.g., Campbell, 1963; Crano & Messe, 1970) as a necessary evantuality if social psychology is to reach some widespread theoretical consensus.

In conclusion, the hyperbolic model, when tested with data not totally suited to its needs, performed better than either of two established formulations with which it was compared. The model seems to fit within a useful theoretical orientation, and to have characteristics appropriate to the data reported in a large number of studies of attitude change. Beyond these considerations, the model is in a form that is open to the consideration of other variables of interest to researchers in attitude change, allowing for the development of a powerful tool for the prediction of attitude, which in turn contributes to the clarification of a number of interesting and important theoretical issues.

References

Aronson, E., Turner, J., and Carlsmith, J. M. Communicator credibility and communication discrepancy as determinants of opinion change. Journal of Abnormal and Social Psychology, 1963, 67, 31-36.

Bochner, S., and Insko, C. Communication discrepancy, source credibility, and influence. Journal of Personality and Social Psychology, 1966, 4, 614-621.

Brewer, M. B. Averaging versus summation in composite ratings of complex social stimuli. Journal of Personality and Social Psychology, 1968, 8, 20-26.

Brewer, M. B., and Crano, W. D. Attitude change as a function of discrepancy and source of influence. Journal of Social Psychology, 1968, 76, 13-18.

Campbell, D. T. Social attitudes and other acquired behavioral dispositions. In S. Koch (Ed.), Psychology: A study of a science, Vol. 6, New York: McGraw-Hill, 1963, pp. 94-172.

Choo, T. Communicator credibility and communication discrepancy as determinants of opinion change. Journal of Social Psychology, 1964, 64, 1-20.

Cooper, R. E. Pretest validity and the prediction of attitude: A further comparison of congruity and summation theories. Unpublished master's thesis, Michigan State University, 1971.

Cooper, R. E., and Crano, W. D. Pretest validity and the prediction of attitude: A further comparison of congruity and summation theories. The Proceedings, American Psychological Association, 1971, 371-372.

Crano, W. D., and Messe', L. A. When does dissonance fail? The time dimension in attitude measurement. Journal of Personality, 1970, 38, 493-508.

Edwards, A. L. Experimental design in psychological research. New York: Rinehart, 1960.

Festinger, L. A theory of cognitive dissonance. Evanston, Ill.: Row, Peterson, 1957.

Fisher, S. and Lubin, A. Distance as a determinant in influence in a two-person serial interaction situation. Journal of Abnormal and Social Psychology, 1958, 56, 230-238.

Freedman, J. Involvement, discrepancy, and change. Journal of Abnormal and Social Psychology, 1964, 69, 290-295.

Hovland, C. I., and Pritzker, H. Extent of opinion change as a function of amount of change advocated. Journal of Abnormal and Social Psychology, 1957, 54, 257-261.

Sears, D. O., and Abeles, R. P. Attitudes and opinions. In P. H. Mussen and M. R. Rosenzweig (Eds.), Annual Review of Psychology, 1969, 20, 253-288.

Sherif, C., Sherif, M., and Nebergall, R. Attitude and attitude change. Philadelphia: Saunders, 1965.

Sherif, M., and Hovland, C. I. Social judgment. New Haven: Yale Univ. Press, 1961.

Zimbardo, P. Involvement and communication discrepancy as determinants of opinion conformity. Journal of Abnormal and Social Psychology, 1960, 60, 86-94.

Figure 1

Absolute and relative discrepancy versions

of hyperbolic model of attitude change